Controlled pattern formation at moving contact lines of surfactant covered thin liquid films

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ABSTRACT

Surfactant monolayers can be transfered from a liquid subphase onto a solid substrate by use of well-established methods like Langmuir-Blodgett transfer, that is, controlled withdrawal of the solid from the surfactant covered liquid bath.

Under certain experimental conditions, an instability of the transfer process has been discovered, that leads to the formation of highly regular periodic stripe patterns of merely a few hundred nanometers period length [1].

This phenomenon results from phase decomposition in the monolayer triggered by an interaction with the substrate at the contact line. It can be understood in terms of a model describing a receding contact line of a surfactant covered liquid film in the vicinity of a monolayer phase transition [2,3]. The model comprises two coupled nonlinear partial differential equations that have been derived within the framework of the lubrication approximation.

On the basis of this model, we discuss possibilities to control the properties of the transfered patterns. As has been predicted recently, chemically prepatterned substrates can be utilized to yield structures of higher complexity [4], such as well-aligned arrays of circular monolayer domains. Such structures can be applied in exciton experiments and might even provide self-assembled templates for quantum dots.

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